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COMPARATIVE ANALYSIS OF FILTERS FOR TEXT EXTRACTION FROM NOISY IMAGES

Dixcha Gusain*, Binay Kumar Pandey, Hardwari Lal Mandoria
Research Scholar, Department of Information Technology, G.B. Pant University of Agriculture & Technology, Pant Nagar-263145 UK INDIA.
Assistant Professor, Department of Information Technology, G.B. Pant University of Agriculture & Technology, Pant Nagar-263145 UK INDIA.
Professor and Head, Department of Information Technology, G.B. Pant University of Agriculture & Technology, Pant Nagar-263145 UK INDIA.

ABSTRACT

With rapid growth of the internet the amount of image and video data is increasing exponentially. The text data present in images and videos is useful for automatic annotations, indexing and structuring of images. There is huge increment in images and video database online. In such database, there is need to fetch, explore and inspect the images and videos. Text extraction plays a major role in finding vital and valuable information. Noise is an important factor that influences the quality of image which is mainly produced in the processes of image acquirement and transmission. An image can be contaminated by noise like salt and pepper noise, random valued impulse noise, speckle noise and Gaussian noise. For the removal of noise from images, the filtering algorithm like adaptive filter, average filter, maximum filter, median filter, minimum filter, trimmed filter and wiener filter are used. After removing noise from input complex image the text is extracted in binary form through proposed algorithm. The proposed method uses the techniques of local contrast, local gradient, adaptive map contrast, canny edge detection for detection of text strokes and Otsu threshold for calculation of threshold value .On the basis of calculated threshold value the pixels are classified into background and foreground .A comparative study of some popular existing filtering method is done for text extraction from complex images .The proposed method is simulated in MATLAB to verify and validate the performance analysis.

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KEYWORDS: Binarization, Noise, Adaptive filter, Average filter, Maximum filter, Median filter, Minimum filter, Trimmed filter, Wiener filter.

INTRODUCTION

Text extraction from image is concerned with extracting the proper and suitable text data from the collection of images. Image binarization is the process of converting a image into a binary image. A binary image is the digital image which has two colors i.e. 0 and 1.The pixel value 0 represents the black color for foreground and 1 represent the white color for background. Thresholding is a technique which is used for image binarization. The pixels of an image are distinguishes as a background and foreground by comparing them to threshold value. Thresholding is further classified as global and local. Global threshold method is suitable for images with contrast foreground and background. There are certain images which contain large amount of noise, illumination and uneven lightning. In such cases, local threshold is suitable. The binary images [4] frequently occur in image processing as masks or as the outcome of segment and threshold. Document image binarization [12] is generally performed in the pre-processing phase of the distinctive archive picture handling related requisitions, for example optical character distinguishment and report picture recovery. There has been an increased use of cameras in acquiring document images as an alternative to traditional flat based scanners and research towards camera based document analysis is growing[3].In image processing system, a binarization process is done before the analysis and recognition procedures. Much research work has been done in the field of binarization but the effects of image filters before applying binarization algorithm on images for text extraction is still an area of study. This dissertation has focused on effects of different filtering techniques like wiener, wavelet denoising, average, and median and trimmed on image binarization. This paper is organized as follows; Section II includes noise and filtering methods. The proposed binarization technique is shown

in section III. Section IV and V includes the performance metrics and results simulated using MATLAB. In Section VI there is a brief conclusion.

Figure1: Original Image [8]

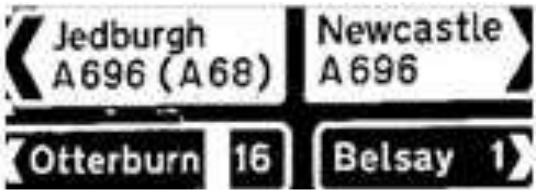


Figure2: Binarized Image

NOISE AND FILTERING METHODS

The aim of digital image processing is to improve the potential information for human interpretation and processing of image data for storage, transmission, and representation for autonomous machine perception. The attributes of an image deteriorate due to contamination of various types of noise: Additive white Gaussian noise, Rayleigh noise, Impulse noise etc. corrupt an image during the processes of acquisition, transmission and reception and storage and retrieval.

The principal sources of noise in digital images arise during image acquisition and/or transmission. The performance of image sensors is affected by a variety of factors such as environmental conditions during image acquisitions, and quality of sensing elements themselves. Images are corrupted during transmission principally due to electromagnetic interference in a channel employed for transmission. Following are the filters which are used in proposed algorithm:

a) Trimmed Average Filter

In order to calculate the α-trimmed filter, the data should be sorted low to high and summed the central part of the ordered array. The number of data values which are dropped from the average is controlled by the trimming parameter α which on the other side of the coin, we already know that the moving average filter suppresses additive white Gaussian noise better than the median filter, while the median filter is better at preserving edges and rejecting impulses [2] . The best choice taking advantages of both moving average and median filter was proposed called the a-trimmed mean filter [1].

b) Median Filter

Median filtering is a common image enhancement technique for removing salt and pepper noise. Because this filtering is less sensitive than linear techniques to extreme changes in pixel values, it can remove salt and pepper noise without significantly reducing the sharpness of an image. Median filtering is a nonlinear operation used in image processing to reduce "salt and pepper" noise.

c) Adaptive Filter

Adaptive filter is performed on the degraded image that contains original image and noise. The mean and variance are the two statistical measures that a local adaptive filter depends with a defined mxn window region. They can be thought of as self-adjusting digital filters.

d) Wiener Filters

Wiener filters play a central role in a wide range of applications such as linear prediction, echo cancellation, signal restoration, channel equalization and system identification. The main aim of this technique is to filter out noise that has corrupted the signal. The Wiener filter minimizes the mean square error between the estimated random process and the desired process. Wiener filter is a low pass filter an intensity image that has been degrade by constant power additive noise.

e) Maximum & Minimum Filter

Minimum and maximum filters, also called as erosion and dilation filters, respectively, are morphological filters that work by looking a neighbourhood around each pixel. From the list of neighbour pixels, the minimum or maximum value is found and stored as the corresponding resulting value.

f) Average Filter

The average or mean filter is a simple filter that replaces the center value in the window with the average (mean) of all the pixel values in the local window. The window, or kernel, is usually square but can be any shape or of any matrix size.

TEXT EXTRACTION METHOD

This section contains the proposed binarization technique. The proposed technique consists of three parts: .In first part the filtering techniques are applied to the input image for removing the noise and restore it .It will improve the visibility of the input image.. In second part the local image contrast and local image gradient techniques are applied to the restored image for balancing the image variation within the images. In last part true binarization is done. The contrast map are going to binarized through using global thresholding method it will be integrated with canny edge detection to recognize the text stroke edge pixels. The proposed method is easy, robust and creates significant result over existing technique.

Algorithm for Text Extraction through Binarization

Step 1: First of all images will be taken for the experimental purpose.
Step 2: Apply the filtering techniques for smoothing, removing noise and restoring the input images
Step 3: If input image is a color image then it will be converted into a gray scale image
Step 4: Gradient image and contrast image techniques are applied to the input image.
Step 5: Adaptive contrast map will come in action to improve the contrast of the input image.
Step 6: The edges of the text strokes are detected through canny edge detector.
Step 7: Calculate the threshold value.
Step 8: Apply Otsu thresholding to convert the image into a final binarized image
Step9: A final pre-processing is done on binarized image for text extraction.

SIMULATION PARAMETERS

We have performed analytical simulation to evaluate and compare the performance of the filters. We also define various performance metrics used for evaluation in our comparison of filters.

4.1 Peak Signal to Noise Ratio

It is defined as the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. Because many signals have a very wide dynamic range, PSNR is usually expressed in terms of the logarithmic decibel scale. The PSNR (in dB) is defined as:

$$PSNR = 10.\log_{10}(\frac{MAX_I^2}{MSE})$$

4.2 Negative Rate Metric

Negative rate metric measures pixel mismatch rate between the input image and result image.

$$NRM = \frac{\frac{N_{FN}}{N_{FN}+N_{TP}} + \frac{N_{FP}}{N_{FP}+N_{TN}}}{2}$$

Where$N_{TP}, N_{FP}, N_{TN}, N_{TN}$ denote the number of true positives, false positives, true negatives, and false negatives respectively.

4.3 Accuracy

Accuracy is defined as the ratio of the correctly and incorrectly recognized characters to the sum of correctly and incorrectly detected and recognized characters, false positive and false negatives. It is used to describe the closeness of a measurement to the true value and an accuracy of 100% means that the measured values are exactly the same as the given values.

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

4.4 Distance reciprocal distortion metric

The Distance Reciprocal Distortion Metric (DRD) has been used to measure the visual distortion in image. It properly correlates with the human visual perception and it measures the distortion for all the S flipped pixels as follows:

$$DRD = \frac{\sum_{k=1}^{S} DRD_k}{NUBN}$$

DRD_k equals to the weighted sum of the pixels in the 5x5 block of the input image that differ from the kth flipped pixel at (x,y) in the binarized result image. NUBN is the number of the non-uniform (not all black or white pixels) 8x8 blocks in the input image.

4.5 Precision

Precision in digital image retrieval is the fraction of the documents that are relevant to the query that are successfully retrieved.

$$Precision\ Rate = \frac{TP}{TP + FP}$$

Where TP is True Positive value , FP is False Positive value and FN is false negative.

4.6 F-Measure

The F-Measure is the harmonic mean of recall (R) and precision (P) values. This metric measures how well proposed algorithm can retrieve the desire pixels.

$$F - Measure = \frac{2 * Precision * Recall}{Precision + Recall}$$

4.7 Specificity

The specificity is the number of true negative results divided by the sum of the numbers of true negative plus false positive results where True positive is correctly identified data in image, False positive is incorrectly identified data in image, True negative correctly rejected data in image and False negative is incorrectly rejected data.

DISCUSSION OF SIMULATION RESULTS

In this section, performance of proposed algorithms for text extraction from complex images is evaluated using different filters in terms performance metrics. The performance analysis of routing protocols is done in MATLAB. The three images are considered for the experimental purpose [3] and on the basis of the results the best filter is checked for that input image.

Input Image with Speckle Noise

The calculated values for different filters for given input image:

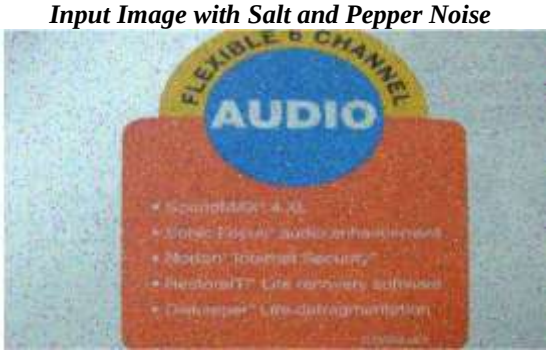
Filtering Methods	Accuracy	DRD	F-Measure	NRM	Precision	PSNR	Specificity
Adaptive Filter	0.7132	12.2243	0.0124	0.5161	0.6385	5.4237	0.7351
Average Filter	0.9308	12.4802	0.0110	0.5000	0.7178	11.6019	1.0000
Maximum Filter	0.9594	9.4423	0.0453	0.4997	0.9134	12.9623	1.0000
Median Filter	0.9583	9.4602	0.0183	0.5000	0.9032	13.7968	0.9998
Minimum Filter	0.9460	9.8490	0.0389	0.5234	0.5321	13.7968	0.9998
Trimmed Filter	0.9529	12.1343	0.0434	0.5000	0.9130	13.2699	1.0000
Wiener Filter	0.9580	9.8500	0.0307	0.4997	0.8645	13.0413	0.9999

Input Image with Gaussian Noise

The calculated values for different filters for given input image:

Filtering Methods	Accuracy	DRD	F-Measure	NRM	Precision	PSNR	Specificity
Adaptive Filter	0.6967	20.4257	3.8455	0.5477	0.0423	11.0592	0.7309
Average Filter	0.9216	8.5363	0.0195	0.4999	0.2857	12.3968	1.0000
Maximum Filter	0.9424	8.5363	0.0265	0.4997	0.1642	12.3968	0.8997
Median Filter	0.9482	11.0706	0.1618	0.4997	0.1642	12.8593	0.9998
Minimum Filter	0.8952	18.7968	4.2457	0.5045	0.0532	9.7968	0.9557
Trimmed Filter	0.9434	12.1343	0.0538	0.4991	0.3077	12.4681	1.0000
Wiener Filter	0.9410	12.28860	0.1806	0.4997	0.1429	12.2891	0.9895

Input Image with Salt and Pepper Noise



The calculated values for different filters for given input image:

Filtering Methods	Accuracy	DRD	F-Measure	NRM	Precision	PSNR	Specificity
Adaptive Filter	0.5868	26.4197	0.0744	0.6215	0.0402	3.8387	0.6850
Average Filter	0.9293	10.0979	0.0108	0.5000	0.9543	11.5052	0.7689
Maximum Filter	0.8229	25.2479	0.0086	0.5000	0.7654	7.5176	0.8999
Median Filter	0.9649	9.1618	0.1572	0.4996	1.000	13.0567	1.0000
Minimum Filter	0.7189	27.7578	0.0217	0.4999	0.6654	5.5108	0.4563
Trimmed Filter	0.9505	9.6301	0.0462	0.4999	0.9995	13.0567	1.0000
Wiener Filter	0.8313	17.1161	0.0045	0.5000	0.7655	7.72891	0.9992

CONCLUSION

In this paper analysis of filters on complex digital image for text extraction is based on parameters accuracy, DRD, F-Measure, NRM, Precision, PSNR and Specificity. The three images are affected by noise. The quality of those images is degraded by Gaussian noise, Speckle noise and Salt and Pepper noise. For image with Gaussian noise, the median filter is showing effective result. Maximum filter is showing best result for image in which image quality is degraded by Speckle noise. For Salt and Pepper noisy image, the median filter is showing the best performance in terms of simulation parameters. The proposed method retains the useful textual information more accurately and thus, has a wider range of applications compared to other conventional methods.

REFERENCES

[1] Bednar, J. and Watt, T. L. (1984). Alpha-trimmed means and their relationship to median filters. *Acoustics, Speech and Signal Processing, IEEE Transactions on*, 32(1), 145-153.
[2] Pitas, I. and Venetsanopoulos, A. N. (1992). Order statistics in digital image processing. *Proceedings of the IEEE*, 80(12), 1893-1921.
[3] T Kasar , J Kumar , A G Ramakrishnan," Font and background color independent text binarization " In Proceedings of 2nd International Workshop on Camera Based Document Analysis and Recognition,2007
[4] Stathis, Pavlos, Ergina Kavallieratos, and Nikos Papamarkos. "An evaluation survey of binarization algorithms on historical documents." Pattern Recognition, 2008. ICPR 2008. 19th International Conference on. IEEE, 2008.
[5] Su, Bolan, Shijian Lu, and Chew Lim Tan. "Combination of document image binarization techniques." Document Analysis and Recognition (ICDAR), 2011 International Conference on. IEEE, 2011.
[6] Papavassiliou, Vassilis, et al. "A Morphology Based Approach for Binarization of Handwritten Documents." Frontiers in Handwriting Recognition (ICFHR), 2012 International Conference on. IEEE, 2012.
[7] Su, Bolan, Shijian Lu, and Chew Lim Tan. "A learning framework for degraded document image binarization using Markov random field." Pattern Recognition (ICPR), 2012 21st International Conference on. IEEE, 2012.

[8] Satish Kumar, Sunil Kumar, Dr. S.Gopinath," Text Extraction From Images" Image Processing, International Journal of Advance Research in Computer Engineering and Technology Volume 1 ,Issue 4,June 2012.
[9] Patvardhan, C., A. K. Verma, and C. Vasantha Lakshmi. "Document image denoising and binarization using Curvelet transform for OCR applications."Engineering (NUiCONE), 2012 Nirma University International Conference on. IEEE, 2012.
[10] Su, Bolan, Shijian Lu, and Chew Lim Tan. "Robust document image binarization technique for degraded document images." Image Processing, IEEE Transactions on 22.4 (2013): 1408-1417.
[11] Pratikakis, Ioannis, Basilis Gatos, and Konstantinos Ntirogiannis. "ICDAR 2013 Document Image Binarization Contest (DIBCO 2013)." Document Analysis and Recognition (ICDAR), 2013 12th International Conference on. IEEE, 2013.
[12] Sehad, Abdenour, et al. "Ancient degraded document image binarization based on texture features." Image and Signal Processing and Analysis (ISPA), 2013 8th International Symposium on. IEEE, 2013.
[13] Nafchi, Hossein Ziaei, Reza Farrahi Moghaddam, and Mohamed Cheriet. "Application of Phase-Based Features and Denoising in Postprocessing and Binarization of Historical Document Images." Document Analysis and Recognition (ICDAR), 2013 12th International Conference on. IEEE, 2013.
[14] Parker, Jon, Ophir Frieder, and Gideon Frieder. "Automatic Enhancement and Binarization of Degraded Document Images." Document Analysis and Recognition (ICDAR), 2013 12th International Conference on. IEEE, 2013.
[15] Jagroop Kaur, Dr.Rajiv Mahajan "Improve Degraded Document Image Binarization using Guided Image Filter" ,International Journal of Advanced Research in Computer and Communication Engineering Volume 3, Issue 5, May 2014.
[16] K.Ntirogiannis,B.Gatos,I.Pratikaki,"A combined approach for the binarization of handwritten document images", Pattern recognition letters, Volume 35,pp 3-15,January 2014.
[17] Gaceb, Djamel, Frank Lebourgeois, and Jean Duong. "Adaptative Smart-Binarization Method: For Images of Business Documents." Document Analysis and Recognition (ICDAR), 2013 12th International Conference on. IEEE, 2013.
[18] Wagdy, M., Ibrahima Faye, and Dayang Rohaya. "Fast and efficient document image clean up and binarization based on retinex theory." Signal Processing and its Applications (CSPA), 2013 IEEE 9th International Colloquium on. IEEE, 2013.
[19] Jagroop Kaur, Dr.Rajiv Mahajan "Improve Degraded Document Image Binarization using Guided Image Filter" ,International Journal of Advanced Research in Computer and Communication Engineering Volume 3, Issue 5, May 2014.
[20] K.Ntirogiannis,B.Gatos,I.Pratikaki,"A combined approach for the binarization of handwritten document images", Pattern recognition letters, Volume 35,pp 3-15,January 2014.